T131B

A Mixed Methods Approach to Understanding Water Availability in the Caribbean

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Abstract

The Caribbean is a region that experiences a decrease in rainfall or "drought" in the midst of its rainy season. Farmers have always had to adjust their practices to deal with this mid-summer dry spell (MSD). Now, with global warming, drought is becoming commonplace in the Caribbean and it is expected to worsen in the future according to global and regional climate models. Essentially, the MSD climate mode will strengthen and impact a larger proportion of the summer growing season. In addition, increasing temperatures year-round will lead to further water loss and agricultural stress. While the understanding of the atmospheric causes of drought in the Caribbean has advanced greatly over the last several years, what is less well understood is the farmers' perception of drought and their adaptation strategies. Many other non-climatic factors are critical to the resiliency of farming in the face of drought, including access to irrigation, personal capital, social networks, and government assistance. This paper explores the impact of the MSD and climate change on agricultural productivity through satellite and station observations in the Caribbean and presents some preliminary interview data to gain some insight on the farmer's perspective on drought: is it a problem, and if so can lessons from the MSD help farmers to adapt?

Introduction

• Climate change is expected to have a significant impact upon Caribbean agriculture, with implications for employment, export earnings, and food security (Barker, Dodman and McGregor 2009).

• Our current work is focused on St. Elizabeth Parish, Jamaica, known as the 'bread basket' of the country because it supplies much of the island's domestic food crops (Beckford, Barker, and Bailey 2007) and it experiences a significant mid-summer dry spell (Gamble et al. 2010).

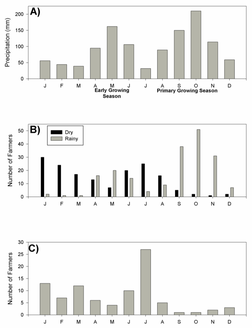


Figure 1. A) Mean monthly rainfall (mm) for Southfield, St Elizabeth Parish, Jamaica. B) Frequency of farmer perception of dry and rainy months. C) Frequency of famer perception of the most severe dry month in terms of crop damage (From Gamble et al. 2010).

• The first component of our study focuses on *vulnerability*. O'Brien and Leichenko (2000) have described what they call a 'double exposure', in which particular regions, groups, or ecosystems may face simultaneous negative impacts from both climate change and economic reorganization. Although O'Brien and Liechenko (2000) focus on the consequences of economic globalization, particularly the uneven impacts of trade liberalization on local communities, here we are chiefly concerned with dynamics that are more regional in scope (Figure 2 below).

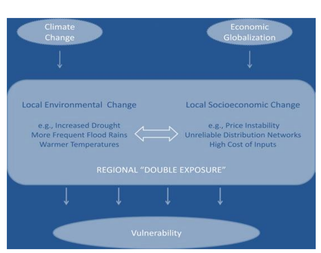


Figure 2.

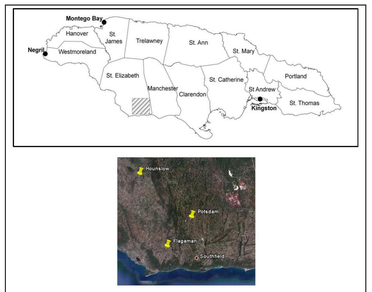
• The second component of our research focuses attention on the ways in which different farming systems, particularly in terms of the supply and use of water, serve to enhance *resilience* in the face of double exposure.

Methodology

• There are good reasons to believe that the different systems of agricultural production and water delivery within the region will have an influence on farmer resilience in the context of their double exposure to environmental and economic stress. We plan to investigate these relationships through a combination of quantitative and qualitative analysis of four different water delivery systems (Fig. 2):

– Farms without a formal irrigation network and which therefore rely upon hand watering of crops (Fig. 2a).
– Farms making use of a gravity-fed, drip irrigation system (Fig. 2b).
– Farms with access to government-owned irrigation infrastructure through underground pipes (Fig. 2d).
– Greenhouse operators (Fig. 2c).

Figure 3.



Community	Approximate Elevation	Annual Rain	Monthly Rain	Maximum Rain Month	Minimum Rain Month
Potsdam	800m	1128mm	94mm	April 165mm	July 40mm
Hounslow	25m	1128mm	94mm	October 220mm	February 35mm
Flagaman	250m	912mm	76mm	October 160mm	February 30mm

Figure 4.

• Specific study sites will be: Flagaman, Potsdam, and Hounslow (Fig. 4)

The *Potsdam* district is the highest elevation of the study sites (800 m), with a resulting climate that is cooler and wetter than the coastal plain. Cool-weather crops such as carrot, cabbage and Irish potato are common here. Some of the farms in this area are larger than average, but the rolling terrain makes the use of mechanized equipment difficult, and heightens the risk of soil erosion. More plentiful rainfall means that fewer farmers practice irrigation.

The *Flagaman* area is comprised of flatter land at lower elevations (250 m), with a generally warmer and drier climate than other parts of the Parish. The area is not supplied with irrigation infrastructure but has been the target of the National Irrigation Commission (NIC)'s Black Tank Program, which provides funding for the purchase of gravity-feed drip irrigation, as well as trucked water at subsidized rates. However, according to Campbell, Barker, and McGregor (2011) 45% of the time farmers employ the labor-intensive bucket or watering can method, while only 3% use the drip irrigation technique due to the set up costs. Most farmers in Flagaman practice the traditional 'dry-farming' technique of mulching with guinea grass, which is an added expense. Typical farm size in this area is modest, and major crops include scallion, melon, tomato, beet root, eggplant, thyme.

The *Hounslow* area contains the flattest land with the lowest elevation (25 m). Hounslow receives the same annual rainfall as Potsdam, but with a wetter fall and drier spring. However, Hounslow is unique to the rest of the parish for two reasons: first, because the area has some 3000 acres of irrigated land; and second, because it has been the focus of recent government efforts to develop "a modern state-of-the-art agricultural cluster" (Myers 2009) in the region. Key crops include sweet potato and peanuts, which are generally grown on flat plots of modest size, and often irrigated using a sprinkler system. Despite the existence of irrigation infrastructure, some of the land is owned by absentee landlords, and is not cultivated or is used for grazing cattle, something the NIC is trying to address. The Hounslow Irrigation Scheme dates from the 1970s, when the area was part of the Manley government's 'Food Farm' program. It comprises 580 hectares of land, and currently serves some 400 farmers. The system has been refurbished in recent years as part of the National Irrigation Development Plan (NIDP), funded by the Caribbean Development Bank. The NIDP also included an expansion of irrigation lines in the Beacon-Little Park area.

• Tools for assessing vulnerability:

Analysis of Climate Variability: Data will be derived from a combination of archived *in situ* and remotely sensed temperature and precipitation records and a mesonet of precipitation, temperature, and soil moisture instrumentation deployed in the study area (Fig. 5). Data will be used to produce the following:

– Mean annual climatology for each location including normal conditions and variability assessment;
– Period of record precipitation and temperature variability assessment;
– Prediction of future climate and associated variability;
– Annual crop calendar including farmer preferred sowing, growing, harvesting schedules, and water use;

Analysis of Market Variability: Investigation will focus on key factors previously identified by farmers as important to their success: cost of inputs, market price, networks of distribution, and access to water. Farm gate prices for agricultural goods are available through the Jamaica Agriculture Market Information System. Prices will be tracked over time and compared to seasonal trends in climate and market demand. The general structure of the regional agricultural economy will be documented from interviews with two different groups of key informants.

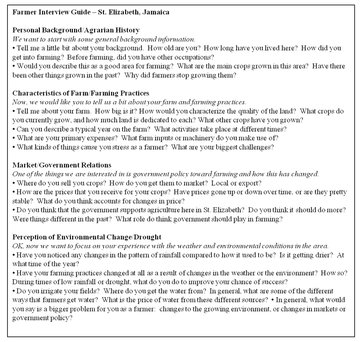
– Interviews with farmers in different regions of St. Elizabeth Parish (see Fig. 6);
– Interviews with key actors within networks of marketing and distribution;

• Tools for assessing resilience:

Detailed Survey of Agricultural Producers: Farm visits will be used to document each farm's environmental characteristics, typical farming practices and planting strategies, use and control of water, and general perceptions about market conditions and climate change. Data will be gathered through the use of a structured survey, and follow-up semi-structured interviews. The survey instrument will be modeled on a survey that was successfully pilot-tested in the summer of 2011, and will cover household and farm characteristics, as well as attitudes and opinions about both the regional farm economy and environmental change. At the time of the initial survey, data will also be collected on the environmental characteristics of each farm.

Longitudinal Case Studies: Finally, twelve farms (three farms using each type of water system, Fig. 3) will be selected as case studies. Farmers included in the case study analysis will have instruments deployed on their farm, including a tipping bucket rain gauge, soil moisture probe, and temperature sensor (Fig. 5). These data will be used to produce a monthly water budget for each location including a variability assessment. The initial survey and interview methodology will be supplemented by a detailed farm budget and crop schedule, including dates of planting and harvesting, farm expenditures, and the marketing and sale of different crops. Farmers will also be asked to keep a water log in which observations will be recorded regarding perceptions of rainfall, temperature, and crop health, weekly farming activities, and purchase and/or use of irrigation. An example is given in Fig. 7. The purpose of the logs is to develop a detailed record of farmer perceptions and agricultural practices, which can be compared with changes in the water budget calculated from data obtained from field observations.

Figure 5. (top: Potsdam, bottom: Flagaman)



Farmer Interview Guide – St. Elizabeth, Jamaica

Personal Background/Agrarian History
We want to start with some general background information.
• Tell me a little bit about your background. How old are you? How long have you lived here? How did you get into farming? Before farming, did you have other occupations?
• Would you describe this as a good area for farming? What are the main crops grown in this area? Have there been other things grown in the past? Why did farmers stop growing them?

Characteristics of Farm Farming Practices
Now, we would like you to tell us a bit about your farm and farming practices.
• Tell me about your farm. How big is it? How would you characterize the quality of the land? What crops do you currently grow, and how much land is dedicated to each? What other crops have you grown?
• Can you describe a typical year on the farm? What activities take place at different times?
• What are your primary expenses? What farm inputs or machinery do you make use of?
• What kinds of things cause you stress as a farmer? What are your biggest challenges?

Market Government Relations
One of the things we are interested in is government policy toward farming and how this has changed.
• Where do you sell you crops? How do you get them to market? Local or export?
• How are the prices that you receive for your crops? Have prices gone up or down over time, or are they pretty stable? What do you think accounts for changes in price?
• Do you think that the government supports agriculture here in St. Elizabeth? Do you think it should do more? Were things different in the past? What role do think government should play in farming?

Perception of Environmental Change Drought
OK, now we want to focus on your experience with the weather and environmental conditions in the area.
• Have you noticed any changes in the pattern of rainfall compared to how it used to be? Is it getting drier? At what time of the year?
• Have your farming practices changed at all as a result of changes in the weather or the environment? How so?
During times of low rainfall or drought, what do you do to improve your chance of success?
• Do you irrigate your fields? Where do you get the water from? In general, what are some of the different ways that farmers get water? What is the price of water from these different sources? • In general, what would you say is a bigger problem for you as a farmer: changes to the growing environment, or changes in markets or government policy?

Figure 6.

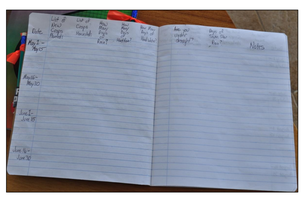


Figure 7.

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